Modeling Crude Oil Mobility of Unconventional Tight Carbonate Reservoir

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Tight unconventional reservoir is known to exist as a thick and fractured limestone formation in west Kuwait that shows good prospect. However, in west Kuwait at this tight and unconventional reservoir, production is difficult. It exhibits low porosity - about 3% - and low matrix permeability, 0.008 - 10 millidarcies. The principal objective of the study is to integrate results obtained from experimental measurements of crude and rock samples from 3-directional wells to build a Mobility model based on this integration. A new, unconventional approach of modeling based on Neural Networks is used to characterize the permeability (K), viscosity (μ) and Mobility (K/μ) of this tight carbonate. Comprehensive data mining of the reservoir will be conducted using a big data developed for this study. This unconventional approach will allow prediction of the future oil production for this formation. This integration study is divided into three phases. Phase I, fluid and rock conventional petrophysical data is performed on 3-directional wells. Phase II, more unconventional data is measured to complement phase I especially in digital representation part of the unconventional tight carbonate reservoir characterization. Phase III involves the interpretation of the data collected in phase I&II and formulate the mobility model. The fluid data will involve viscosity and API analysis of the crude oil, and the rock data will involve routine core data: measurements of (porosity, air-permeability and grain density). Further rock characterization integration includes well-test data, geological data, XRF, XRD data, and finally spectral gamma log data. The second phase presents Digital Rock Analysis. Phase II is integrating pore level image analysis, mainly to understand relationships between porosity and permeability, and wettability outcome of produced contact angle models. Phase III is the data interpretation and modeling. Phase III will introduce unconventional Mobility model, Reservoir Permeability model, and production strategy model. This tight carbonate has a nano-porosity and a nano-permeability, of which has a designation in the unconventional reservoir range part of its complexity and difficult to natural fluid flowing setting. The Wettability Contact Angle θ° of tight carbonate is between 44° to 103° which is considered mixed wettability or medium water wet to weak oil wet. This tight carbonate reservoir may be not suited for primary recovery $\theta° > 30°$; however, it will be excellent for secondary recovery and EOR recovery. In this unconventional tight carbonate reservoir, the Water Mobility is 2.35 times larger than Oil Mobility. A summary of all findings, conclusions and recommendations are produced for developing the future unconventional tight carbonate crude oil production strategy.